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(71) Applicant(s)
Telesensomatic GmbH

(Incorporated in the Federal Republic of Germany)

89070 Ulm, Federal Republic of Germany

(72) Inventor(s)
Michael Lausch
Michael Bockmair

(74) Agent and/or Address for Service
Jensen & Son
70 Paul Street, LONDON, EC2A 4NA, United Kingdom

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(54) **Electronic tag reading/writing using antennae embedded in curtain through which tagged object passes**

(57) An antenna arrangement for reading and/or writing to an electronic data carrier 6 attached to an object 5 comprises a number of antenna coils 4 disposed in or on the flexible strips 2 of a curtain through which the data carrier passes. The objects may be luggage transported on a conveyor belt through the curtain. The arrangement may be used in a sorting system. The flexible strips bend around the object thereby ensuring that at least one coil is close enough to the tag to communicate reliably. Thus high intensity fields and protective screening are unnecessary. A bottom antenna 3 or antenna array communicates with tags attached to the underside of objects. The coils may be wire wound or made in groups by thin film technology. The position and density of coils within each strip may be varied, as can the size and number of strips forming the curtain and their cross sectional shape. The strips may be set at angles to each other forming a zig-zag pattern and more than one curtain may be used. The strips may be formed from solid strip sections held together by hinge like joints or may be cords with antennae attached.

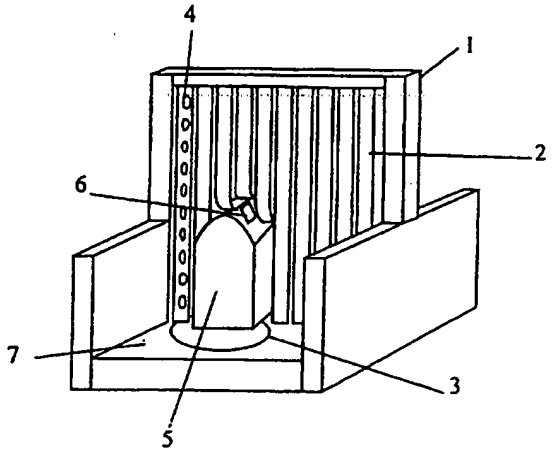

Fig.1

GB 2 305 826 A

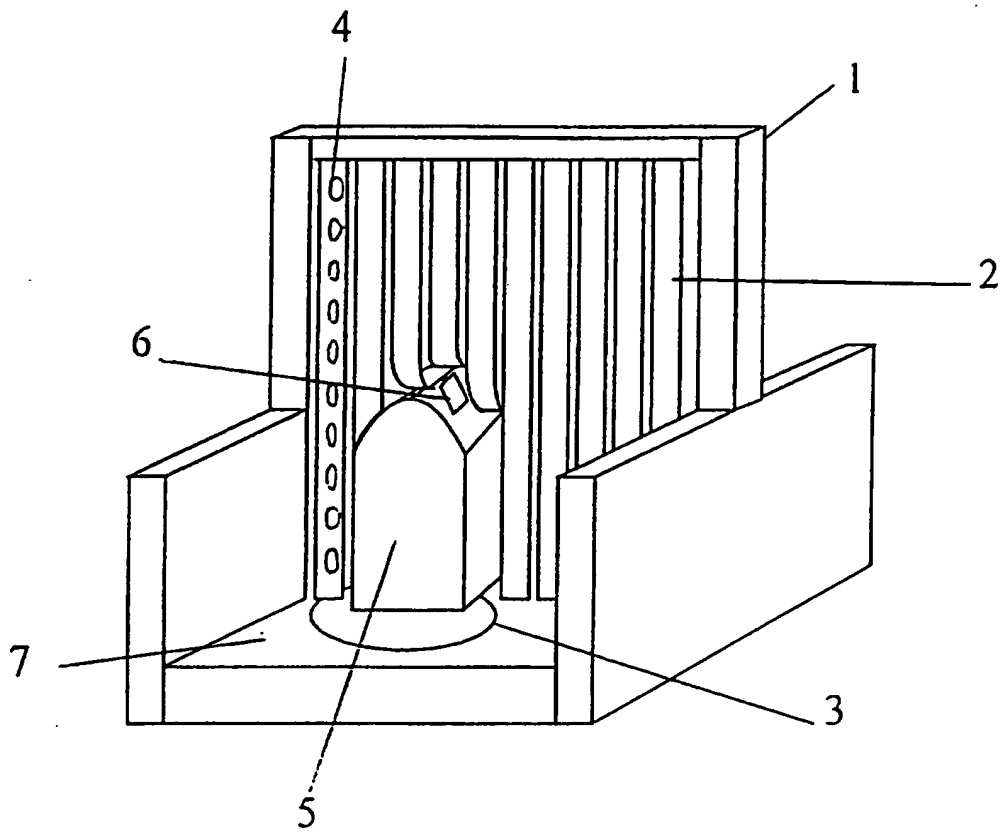

Fig.1

Antenna arrangement for reading and/or writing to electronic data carriers

The invention relates to an antenna arrangement for reading and/or writing to electronic data carriers.

Antenna arrangements of this type are mainly used when objects are identified and/or characterized by means of information/data stored on electronic data carriers (also known as electronic tags or transponders). For this purpose the objects are moved past the antenna arrangements which, during the passage of each object establish an interactive link (i.e. radio link) for a certain time with the electronic data carrier, and during that time exchange information or data with the data carrier. This exchange can be a purely reading process in which the antenna arrangement reads from the data carrier data that are stored there and passes them on to an evaluation unit connected to the antenna arrangement, or a purely writing process, in which data are written via the antenna arrangement to the data carrier and stored there, or a combined reading/writing process in which data are both read from the data carrier and written to it.

Typical applications of such characterization/identification systems occur mainly where logistical tasks have to be solved in bringing piece-goods together or distributing them, in the widest sense. Examples are high-rise shelf stores, in which the goods to be stored are automatically assigned to or recovered from storage locations, or vehicle production lines in which the individual vehicle components are taken automatically from high-rise shelf stores and conveyed to the production point, or postal freight centres in which packets have to be appropriately directed, or luggage conveyor equipment in airports or railway stations, where the luggage of each traveller has to be individually directed according to destination, or container trans-loading areas in ports, where containers are transferred to

railcars, trucks or ships, or the dispatch areas of distribution companies.

For the operation of such characterization/identification systems antenna arrangements are needed, which make it possible to read or write to the electronic data carrier over a short distance and regardless of its spatial orientation relative to the antenna arrangement.

For this purpose, so-called tunnel antennae have already been proposed, which take the form of a tunnel through which the objects to be characterized or identified are moved, such that an interactive link is established between the electronic data carriers attached to the objects and the antenna.

A disadvantage of this arrangement is that the distance between the antenna and the data carrier amounts as a rule to several tens of centimetres. Correspondingly, to transfer sufficient energy to the data carrier without a battery, radiation fields of high intensity have to be emitted by the antenna, which has to be screened on the outside at correspondingly high expense. Such antennae take up a lot of space.

It has also been proposed to use solid metal frame antennae, with which the distance between antenna and data carrier can also amount to several tens of centimetres. In this case too, effective screening of the magnetic field radiated by the frame is only possible at considerable additional expense. Moreover, because of the antenna field null-points, the data carriers must be correctly orientated during their passage through the frame antenna.

The present invention seeks to provide an antenna arrangement suitable for reading and/or writing to electronic data carriers, which can operate with as low as

possible a field intensity and with which data carrier orientation is immaterial.

According to the invention there is provided an antenna arrangement for reading and/or writing to an electronic data carrier and forming a communication link therewith, which antenna arrangement comprises a plurality of antennae, which antennae are connectable to a read/write station, the antennae being disposed on a movable support, which support forms at least part of a curtain, wherein the electronic data carrier is movable through the curtain, whereby the communication link between the electronic data carrier and at least one of the antennae is established.

Preferably the antennae are arranged in groups. Preferably at least part of the support is flexible. Preferably the antennae are disposed along the axis of the support adjacent to one another. Preferably the antennae are uniformly distributed on the support. Preferably the antennae are in the form of flat wire-coils or flat strip-conductor coils. Preferably the coils are produced on or within thin films. Preferably all or at least most of the supports are of substantially equal length. Preferably the number of antennae on each support is substantially the same. Preferably the supports forming the curtain are in the form of cords and/or flat lamellae and/or strips with cross-sections deviating from linear shape. Preferably, the strips have a cruciform, round or elliptical cross-section. Preferably the individual lamellae of the curtain, when at rest, are orientated with the normals to their surfaces substantially parallel. Preferably the surfaces of the lamellae in substantially the same plane. Preferably when at rest, the normals to the surfaces of adjacent lamellae of the curtains are at an angle to one another different from zero, such that overall, in cross-section the lamellae lie along a zig-zag line. Preferably the angle is 90°. Preferably the supports are subdivided in their lengths into

sections of substantially equal length and/or with solid sections connected together by means of hinges or hinge-like means. Preferably, when the electronic data carriers are applied to objects, several curtains are arranged one behind the other or several two-dimensional curtains form in combination a three-dimensional curtain arrangement in the direction along which the objects move. Preferably the supports and/or curtains are attached to the cross-piece of a U-shaped frame with its open end facing downwards. Preferably, a bottom antenna arrangement is located under the curtain and substantially all along its width transverse to the movement direction of the objects. Preferably the bottom antenna arrangement comprises a single bottom antenna or several individual bottom antennae disposed one behind the other transversely to the movement direction of the objects. Preferably, the antenna arrangement is integrated into a conveyor belt unit for the transport of objects. Preferably it is used in a luggage conveyor and/or sorting system.

An advantage of the invention is that while passing through the antenna arrangement, the data carriers are a very small distance away from at least one part of the individual antennae, so that the radiation fields of the antenna arrangement as a whole can be very low. Expenditure on screening measures is correspondingly small, and in individual cases, when the interfering fields are negligibly small, screening can even be omitted.

A further advantage is the compact and inexpensive structure of the antenna arrangement.

A third advantage is that the reading or writing process operates regardless of the orientation of the data carrier at any particular moment.

An exemplary embodiment of the invention will now be

described in greater detail, with reference to the figure which illustrates a preferred design version of the antenna arrangement according to the invention.

The antenna arrangement consists of a U-shaped frame 1 positioned over a conveyor belt 7 with its open end downwards and to whose horizontal cross-piece are attached several flexible lamellar strips 2, forming a curtain through which an object 5 is moved, to which an electronic data carrier 6 is attached. In each of the lamellae 2 a series of individual antennae 4, for example in the form of coils, are embedded one behind the other along the length of the lamella. The individual antennae 4 are connected to a writing/reading device (not shown in the figure). At the bottom, underneath the conveyor belt 7, a further bottom antenna 3 is positioned. The reading/writing device can be arranged separately or, for example, integrated in the metallic frame 1. The coils 4, including their connection leads, can for example be made individually or in groups by thin-film technology and welded into foils, or as wire-wound elements.

During operation the coils can be switched for writing/reading by multiplexer switches in any way desired, for example individually or in the groups of the lamellae. The flexible lamellae 2 bend around and press against the object 5 or its data carrier 6 and thereby ensure that at any time at least one antenna coil 4 is a distance away from the data carrier 6 that suffices for reliable energy input and data communication.

The purpose of the bottom antenna 3 is to establish an interactive link with data carriers 6 that happen to be underneath the objects to which they are attached as they pass through the curtain antenna (in a luggage conveyor system, for example, underneath a suitcase that is upside-down).

It is understood that the invention is not limited to the embodiment illustrated, but rather, can be extended to many similar systems.

For example, corresponding to the expected size of the objects, the length of the lamellae can be made longer at the sides of the lamella curtain than in the middle. The "density" of individual antennae on the lamellae (i.e. the number of antennae per section of lamella) may vary, for example by locating more individual antennae near the bottom of the lamellae than at the top. Also, lamellae near the middle of the curtain can have a larger number of individual antennae than those at the sides.

As seen in the longitudinal direction of the lamellae, the individual antennae need not be strictly in line one behind the other; they can for example form a zig-zag pattern or be distributed in any other way over the surface of the lamellae.

When at rest, the lamellae can be oriented such that the normals to their surfaces are parallel and/or their surfaces are in one plane. It is also conceivable, however, that the normals to the surfaces of adjacent lamellae make between them an angle different from zero (e.g. 90°) such that the lamellae are arranged in a zig-zag.

The lamellae can be subdivided in the longitudinal direction, for example into sections of equal length, and with the lamella sections themselves all solid or inflexible provided the lamellae as a whole remain flexible (for example, by virtue of hinge-like joints between the individual sections).

It can also be considered, instead of the flat lamellae, to use cords to which the individual antennae are attached, or lamellae whose cross-sections (transverse to the

longitudinal direction) are cruciform or circular or elliptical, or whose cross-sections differ in some other way from a linear shape.

Finally, several such curtains can be disposed one behind the other. In this, the spacing of the individual curtains can be so chosen that they remain apart, but it can also be considered to position the curtains close enough to one another for them to form a single "three-dimensional" curtain. In addition, instead of a single bottom antenna, a one-dimensional or two-dimensional array of bottom antennae can be provided.

Claims

1. Antenna arrangement for reading and/or writing to an electronic data carrier and forming a communication link therewith, which antenna arrangement comprises a plurality of antennae, which antennae are connectable to a read/write station, the antennae being disposed on a movable support, which support forms at least part of a curtain, wherein the electronic data carrier is movable through the curtain, whereby the communication link between the electronic data carrier and at least one of the antennae is established.

2. Antenna arrangement according to Claim 1, wherein the antennae are arranged in groups.

3. Antenna arrangement according to Claim 1 or Claim 2, wherein at least part of the support is flexible.

4. Antenna arrangement according to any one of Claims 1 to 3, wherein the antennae are disposed along the axis of the support adjacent to one another.

5. Antenna arrangement according to Claim 4, wherein the antennae are uniformly distributed on the support.

6. Antenna arrangement according to any one of Claims 1 to 5, wherein the antennae are in the form of flat wire-coils or flat strip-conductor coils.

7. Antenna arrangement according to Claim 6, wherein the coils are produced on or within thin films.

8. Antenna arrangement according to any of the preceding Claims, wherein all or at least most of the supports are of substantially equal length.

9. Antenna arrangement according to any preceding

claim, wherein the number of antennae on each support is substantially the same.

10. Antenna arrangement according to any of the preceding Claims, wherein the supports forming the curtain are in the form of cords and/or flat lamellae and/or strips with cross-sections deviating from linear shape.

11. Antenna arrangement according to Claim 10, wherein the strips have a cruciform, round or elliptical cross-section.

12. Antenna arrangement according to Claim 10 or Claim 11, wherein the individual lamellae of the curtain, when at rest, are orientated with the normals to their surfaces substantially parallel.

13. Antenna arrangement according to Claim 12, wherein the surfaces of the lamellae in substantially the same plane.

14. Antenna arrangement according to Claim 10 or 11, wherein when at rest, the normals to the surfaces of adjacent lamellae of the curtains are at an angle to one another different from zero, such that overall, in cross-section the lamellae lie along a zig-zag line.

15. Antenna arrangement according to Claim 14, wherein the angle is 90°.

16. Antenna arrangement according to any of the preceding Claims, wherein the supports are subdivided in their lengths into sections of substantially equal length and/or with solid sections connected together by means of hinges or hinge-like means.

17. Antenna arrangement according to any of the preceding Claims, wherein, when the electronic data carriers are applied to objects, several curtains are arranged one behind the other or several two-dimensional curtains form in combination a three-dimensional curtain arrangement in the direction along which the objects move.

18. Antenna arrangement according to any of the preceding Claims, wherein the supports and/or curtains are attached to the cross-piece of a U-shaped frame with its open end facing downwards.

19. Antenna arrangement according to Claim 18, wherein a bottom antenna arrangement is located under the curtain and substantially all along its width transverse to the movement direction of the objects.

20. Antenna arrangement according to Claim 19, wherein the bottom antenna arrangement comprises a single bottom antenna or several individual bottom antennae disposed one behind the other transversely to the movement direction of the objects.

21. Antenna arrangement according to any of Claims 18 to 20, wherein the antenna arrangement is integrated into a conveyor belt unit for the transport of objects.

22. Antenna arrangement according to any of the preceding Claims, wherein the antenna arrangement is used in a luggage conveyor and/or sorting system.

23. Antenna arrangement substantially as described herein, with reference to and as illustrated in the accompanying drawing.

The Patent Office

11

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Claims searched:	All	**Date of search:**	24 February 1997

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Other: Online Database: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO93/11504 A1	(INDALA) p.10 line 2 - p.11 line 9 & p.13 lines 1-5	1-22
A	JP620044619	(CSK) see abstract and fig.1	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.